including wound healing and myocardial infarction [Gallo et al., Proc. Natl. Acad. Sci. USA 91: 11035-11039 (1994); Li et al., Circ. Res. 81: 785-796 (1997)]; and the native peptide has been shown to be taken up rapidly by a number of different cell types including meschymal cells and endothelial cells [Chan, Y.R. and R.L. Gallo, J. Biol. Chem. 273: 28978-28985 (1998)].

The PR-39 peptide grouping

Native PR-39 peptide is composed of the 39 amino acid sequence shown below (and also by Table 4).

PR-39: Arg-Arg-Arg-Pro-Arg-Pro-Pro-Tyr-Leu-Pro-Arg-Pro-Arg-Pro-Pro-Pro-Phe-Phe-Pro-Pro-Arg-Leu-Pro-Pro-Arg-Ile-Pro-Pro-Gly-Phe-Pro-Pro-Arg-Phe-Pro-Pro-Arg-Phe-Pro (SEQ ID NO:1)

As conventionally known and reported [see for example, U.S. Patent No. 5,654,273], the specific peptide can be substituted using conservative substitutions of amino acids having the same or functionally equivalent charge and structure, except for the required amino acid sequence "Arg-Arg-Arg" at the N-terminus and the intermediate amino acid sequences "Pro-Pro-X-X-Pro-Pro-X-X-Pro" and "Pro-Pro-X-X-X-Pro-Pro-X-X-Pro" where X can be substituted freely using any amino acid. Thus, all of the preferred substituted amino acid sequences are of about the same size and each differ from the native PR-39 peptide sequence only by substitutions in the intermediate portions of the structure.

Merely as illustrative examples and preferred embodiments of the broad membership constituting this PR-39 derived oligopeptide family, the members comprising 15, 11 and 8 amino acid residues respectively in length are presented below as the PR15, PR11, and PR8 entities respectively. For comparison purposes only, the complete amino acid sequence of the native PR-39 peptide is presented as well.

```
                1   2   3   4   5   6   7   8   9   10  11  12  13
PR-39:      Arg-Arg-Arg-Pro-Arg-Pro-Pro-Tyr-Leu-Pro-Arg-Pro-Arg-

                14  15  16  17  18  19  20  21  22  23  24  25  26
            Pro-Pro-Pro-Phe-Phe-Pro-Pro-Arg-Leu-Pro-Pro-Arg-Ile-

                27  28  29  30  31  32  33  34  35  36  37  38  39
            Pro-Pro-Gly-Phe-Pro-Pro-Arg-Phe-Pro-Pro-Arg-Phe-Pro
```

(SEQ ID NO:2)

```
PR-15:          1   2   3   4   5   6   7   8   9   10  11  12  13
            Arg-Arg-Arg-Pro-Arg-Pro-Pro-Tyr-Leu-Pro-Arg-Pro-Arg-

                14  15
            Pro-Pro
```

(SEQ ID NO:3)

```
PR-11:          1   2   3   4   5   6   7   8   9   10  11
            Arg-Arg-Arg-Pro-Arg-Pro-Pro-Tyr-Leu-Pro-Arg
```

(SEQ ID NO:4)

```
PR-8:           1   2   3   4   5   6   7   8
            Arg-Arg-Arg-Pro-Arg-Pro-Pro-Tyr
```

(SEQ ID NO:5)

The PR-39 Oligopeptide Collective

Terminology and nomenclature often pose problems for the reader as to what precisely is meant. Accordingly, for definitional purposes, avoidance of ambiguities, and clarity of understanding, the following terms and titles will be employed herein. The term "PR-39 peptides grouping" includes by definition the native PR-39 structure and all

Experiment 6:

To demonstrate the efficiency of shorter-length peptides which collectively are members of the PR-39 derived oligopeptide family in stimulating angiogenesis in-vivo, a novel peptide, PR11, composed of the first 11 amino acid residues [N-terminal end] of the native PR-39 sequence was purposely synthesized. The amino acid sequence of PR11 is as follows:

```
1   2   3   4   5   6   7   8   9   10  11
Arg-Arg-Arg-Pro-Arg-Pro-Pro-Tyr-Leu-Pro-Arg (SEQ ID NO:7)
```

To introduce the short-length PR11 peptide in-vivo, a mouse Matrigel assay system was utilized. In sum, either 5 $\mu$g/ml of PR11 peptide or 5 $\mu$g/ml of native PR-39 peptide were individually placed into a growth factor-depleted Matrigel pellet; and then each prepared Matrigel pellet was inserted into the peritoneal cavity of a mouse. After 14 days intraperitoneal placement, each pellet was removed from its living host; and each pellet was examined for evidence of new vascularity. The results are graphically presented by Fig. 7. Note that the bar graph of Fig. 7 shows the number of blood vessels [mean$\pm$SD] per 10 high power fields (HPF).

As evidenced by Fig. 7, the analysis of Matrigel pellet vascularity after 14 days incubation in-vivo demonstrated significant induction of angiogenesis in both the PR11 and the native PR-39 pellets. The control Matrigel pellets, however, showed no evidence of angiogenesis as such. Clearly therefore, the short-length PR11 peptide is fully efficacious and effective in stimulating angiogenesis in-vivo.